THE POINT MARSDEN CAMBRIAN BEDS, KANGAROO ISLAND, SOUTH AUSTRALIA

By R. C. Sprigg

[Read 11 November 1954]

SUMMARY

Index fossils (*Redlichia* and *Lusatiops*) have now been found in the Point Marsden beds of Kangaroo Island. They are thought to indicate an uppermost Lower Pre-Cambrian age. These fossils occur in the Emu Bay Shales associated with a succession of slump-bedded sandstones (the Stokes Bay Sandstone) considered to be near the edge of the ancient Cambrian Continental terrace in this region. Ubiquitous internal convolutions within individual sandstone lenses evidence widespread instability with gliding to the south, possibly down a "continental" type slope. The *White Point Limestone* also within the succession is a conglomeratic development of the nature of an outer slope breccia to a reef-like bioherm. Its fragments are extensively squeezed, evidencing lack of consolidation at time of formation, and a few of them contain Archaeocyathina.

In 1928 the late Dr. C. T. Madigan described in detail a group of beds occurring along the north-east coast of Kangaroo Island, north of Kingscote, in which boulders carrying *Archaeocyatha* occurred plentifully. The beds had previously been recorded by Howchin (1899) and Wade (1915). They were variously ascribed to the Cambrian System or later in the Palaeozoic Era. They were described as lying unconformably on the metamorphic core complex of the Island (Kanmantoo Group), which in turn was considered to be Precambrian Age. The Kanmantoo Group is now known to range from the Cambrian to perhaps Ordovician Period. (Sprigg and Campana, 1953.)

Dr. Madigan designated these younger sediments the Point Marsden Beds and considered them to be possibly Post-Cambrian in age. He found raindrop impressions in some of the more slaty horizons, and observed obscure animal tracks, presumed to be those of trilobites. Dr. Madigan returned to the Island in 1945 with a party of students intending to search more diligently for fossils in original situation, but unfortunately developed sickness which was eventually to lead to his untimely death. The expedition was interrupted and little of significance was accomplished, except that a party of students (personal communication by Mr. R. Ayliffe) reported evidence of basal unconformity with the then presumed Precambrian to the west of Stokes Bay.

In 1952, while preparing the four-mile map sheet of Kingscote (published 1954), the writer made several discoveries of considerable significance concerning these beds, including the discovery of marker fossils, and much new evidence concerning the nature and field relations of the sediments as a whole.

DEFINITION AND REGIONAL EXTENT OF THE POINT MARSDEN GROUP

This succession of conglomerates, sandstones, slates and limestones outcrops intermittently along the north coast of Kangaroo Island from Point Marsden, westward probably to Snelling Beach, a distance of about forty miles. Landward it extends south to the base of the Cygnet and Snelling fault escarpments (Sprigg, 1954). The beds are dominantly subhorizontal except in the approaches to each of a set of imbricate (reversed) faults trending east-west to E.S.E.-W.N.W. which hade to the south at about 45 degrees. The beds are Cambrian in age and preserve conformable relationships with underlying phyllites presumed to be uppermost members of the reduced Adelaide System in this area. They abut the Kanmantoo Group along the foregoing fault escarpment, and themselves are cut by deep valleys of Permian age, choked with glacial debris.

THE SEDIMENTARY SUCCESSION

Phyllites of the Adelaide System are overlain conformably by a massive, medium-grained sandstone development, herein named the *Stokes Bay Sandstone*. The formation is possibly 1,000 feet thick but cannot be observed completely because of faulting; it may thicken to the west. It is reddish or whitish in colour and is characterized by marked internal slumping and normal and pseudo-crossbedding (see later). The sandstone is succeeded by grey shales (*Emu Bay Shales*, 300-400 feet thick) with interbedded quartzites, the former of which carry a newly-discovered trilobite fauna. After a break in the succession due to the interposition of Emu Bay, the succession (still dipping easterly) *apparently* continues with purple shales followed by at least 200 feet of the boulder-breccia limestone which will be called the *White Point Limestone*. These are overlain by more slate and boulder beds followed in the extreme east by numerous conglomerate bands, set in cross-bedded sandstone. Unfortunately, due to an accident which befell the writer, this succession was not mapped nor measured in detail. Further field work is required to check for internal faulting which may effect the order of the beds and thicknesses.

The White Point Limestone consists of closely packed, coarse fragments of whitish and yellowish dolomite and limestone, some of which contain *Archaeocyatha*. The boulders frequently attain two feet or more in length and there is little interstitial material. There is little or no evidence of sorting, or of obvious abrasion rounding of fragments throughout the whole mass of the deposit. Frequently the limestone fragments are squeezed in a manner suggestive of compaction following burial, in which case the "boulders" could have been only partially consolidated at that time. Extraneous matter in the limestone breccias consists of not infrequent, small, well-rounded pebbles of unusually red gneissic granite and black schists not found elsewhere on Kangaroo Island, except in the overlying pebble conglomerates of Point Marsden.

THE NATURE OF THE SEDIMENTARY ENVIRONMENT

It has been inferred elsewhere (Sprigg 1952) that Kangaroo Island lay near the platform edge of the ancient Proterozoic-Cambrian continental terrace which constituted the Adelaide (Mio) geosyncline in South Australia. The continental platform locally was a more stable zone extending landwards (north and west) onto neighbouring shelf and shield areas. Beyond the shelf edge, the continental slope environment possibly extended to ocean depths in a south-easterly direction, with steep unstable sediment slopes, which in Cambrian time possibly simulated conditions now existing beyond the south-eastern extremity of the modern Australian Continent. The Point Marsden beds were apparently accumulated near the outer edge of a narrowing continental platform (Platform-edge environment).

There is also reason to believe that positive and negative land movements were in progress at the time. These would have enhanced the tendency to rapidly transport sediments across the platform-edge, and would also have permitted raindrop impressions to be recorded in exposed arid, red bed sediments (now shales), and also the growth, nearby to the north, of shelf-edge bioherms (Archaeocyatha reefs). The climate at this time appears to have been warm, possibly arid, following late Proterozoic glaciation.

Of special interest concerning the nature of this environment are the massive slump structures of the Stokes Bay Sandstone, the presumed contemporaneous Kanmantoo developments to the south, and also the remarkable sedimentary breccia—conglomerate constituting the *White Point Limestone*.

The Stokes Bay Sandstone is remarkable for the magnitude and number of slump structures contained within its mass. Subaqueous sliding and gliding phenomena are almost ubiquitous within the formation, but mostly the structures

are coarse, and evidencing much apparent erosion truncation, which in turn suggests a shallow water environment. One tongue of sandstone, for example, may be flat-bedded but on either "facing" the sediment may be highly contorted and attenuated, in a manner which can only suggest gravity slumping of water-soaked sediment. The undersurfaces of many of the layers are grooved and rounded in the direction of presumed movement, whereas the upper surfaces are truncated and on occasions may be ripple marked.

By way of comparison, the more quartzitic members and those within the Kanmantoo Succession to the south are thinner and display far more attenuated slumps and "glide-rolling." By the latter is meant the tendency for folds to develop within a particular slumped bed, and to curl over in the direction of gravitational movement; these become extremely attenuated to finish as "extruded" recumbent folds strongly recalling alpine fold nappes on vastly reduced scales. Study of these remarkable features (which have since been found to be well developed in the Ordovician Sandstones of the Indulkana Range, in north-western South Australia) may provide important leads to Alpine "tectonics."

In the Kanmantoo beds these slump structures are almost always eroded on the surface by subsequent slumped sediments, but the surfaces, unlike those of gliding formations within the Stokes Bay Sandstone, are parallel with the base and do not show the same tendency to inter-surface irregularity. This is thought to argue a deeper water environment and steeper slopes for the former, a supposition supported by the poorer sorting and Flysch-like character of the Kanmantoo Succession generally (Sprigg and Campana, 1953).

In this way it is deduced that the Stokes Bay Sandstone is a terrace platform edge development, adjacent to a steep continental slope. Its sands are well sorted, but the element of instability consequent upon a platform-edge location, and accentuated perhaps also by regional uplift and consequent coastal migration to seawards, is always present.

In this light, the origin of the *White Point Limestone* breccias may now be contemplated a little more clearly. As described previously, these sediments contain plentiful *Archaeocyatha* as remanié boulders which, by their coarseness, and the absence of obvious abrasion rounding could not have travelled far. Also, the boulders appear to have been unconsolidated at the time of deposition, being subsequently squeezed by vertical loading pressures; the environment of the outer reef talus slope is suggested. This is in keeping with the probable habitat of *Archaeocyatha* which are considered to have lived in bioherms simulating modern barrier reefs and their associated coral meadows. Their preference for warm seas, on an east-facing continental coast, further enhances the analogy which however should not be taken too far for these problematic sponge-like creatures are only occasionally found in densely massed colonies. Another complication concerns the occurrence of numerous well-rounded pebbles of red granite and black schist which the writer knows only from northern Yorke Peninsula (*e.g.*, Point Pearce, Pine Point, etc.). In a theory involving "barrier" type reefs, these could only enter such an environment of restricted clastic sedimentation *via* floating sea weeds with holdfasts. The writer can see no obvious alternative explanation, as these granite and schist fragments are well rounded. If, however, some local fault escarpment with breccia and talus developments is inferred, hard rock fragments would be far less abraded than the soft tumbled limestone fragments, which is not the case.

In consideration of the fossil fauna, other than the *Archaeocyatha*, the Point Marsden environment was obviously not always one of active coarse clastic sedimentation. The occurrence of abundant trilobites and brachiopods suggests a relatively shallow water environment with a muddy bottom, interrupted only by local sand banks.

THE FOSSIL FAUNA

At least two richly fossiliferous but narrow zones occur in slates about 200 yards north-west of the Emu Bay Jetty. The horizons occur about 100 feet above the *Stokes Bay Sandstone* and below the *White Point Limestone*. Dr. M. F. Glaessner, who has examined the fauna and who will describe it elsewhere, records the following species:

Redlichia n. sp., *Lusatiops* n. sp., *Acrothele* sp., *Hyolithes* sp.

Dr. Glaessner observes that the Family Protolenidae in general, and *Lusatiops* in particular, are considered as restricted to the Lower Cambrian where they characterise one of the youngest zones. *Redlichia* is reported as ranging from Lower to Middle Cambrian. The two genera do not appear to have been found previously associated in the same beds. On this basis the fossiliferous beds of Kangaroo Island are provisionally placed in the uppermost Lower Cambrian.

REFERENCES

GLAESSNER, M. F. 1952 A Cambrian Fauna from Kangaroo Island, South Australia. Unpublished report, Department of Mines. South Australia

HOWCHIN, W. 1899 Notes on the Geology of Kangaroo Island, with special reference to evidences of extinct glacial action. Trans. Roy. Soc. S. Aust., 23, pt. 11

HOWCHIN, W. 1903 Further Notes on the Geology of Kangaroo Island, ibid, 27, pt. 1

MADIGAN, C. T. 1927 Preliminary Notes on new evidence as to the age of formations on the North Coast of Kangaroo Island, S. Aust. Trans. Roy. Soc. S. Aust., 52

SPRIGG, R. C. 1952 Sedimentation in the Adelaide Geosyncline and the formation of the Continental Terrace. Sir Douglas Mawson Anniversary Vol.

SPRIGG, R. C. 1954 Kingscote 4-mile Sheet. Geological Atlas, Geological Survey of South Australia (in press)

SPRIGG, R. C., and CAMPANA, B. 1953 The Age and Facies of the Kanmantoo Series of the Eastern Mount Lofty Ranges and Kangaroo Island, S.A. Aust. Journ. Science, August, 1953

WADE, A. 1915 The Supposed Oil-bearing areas of South Australia. Bull 4. Geological Survey of South Australia